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(54) Abstract Title
Inter-frequency measurement during a predetermined frame of a common channel which has omitted access channel data

(57) A spread spectrum communication network having a common channel, the channel comprising a plurality of frames for containing access channel data and paging channel data for communication to a plurality of radiotelephones, the spread spectrum communication network comprising a controller arranged to omit access channel data from a predetermined frame of the common channel to allow a radiotelephone to perform an inter-frequency measurement during the predetermined frame.

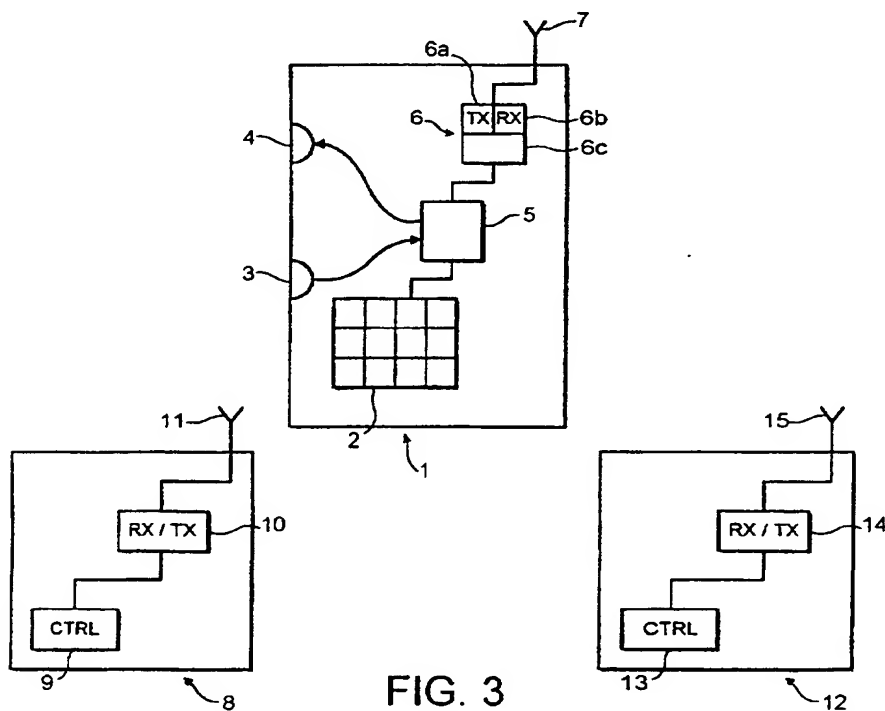


FIG. 3

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

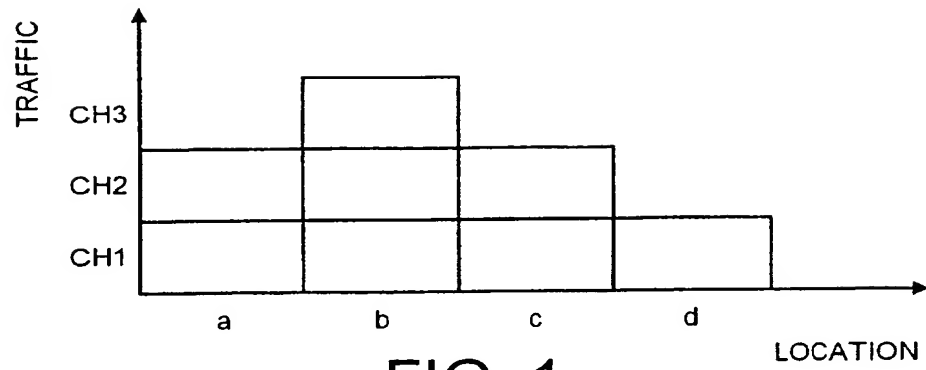


FIG. 1

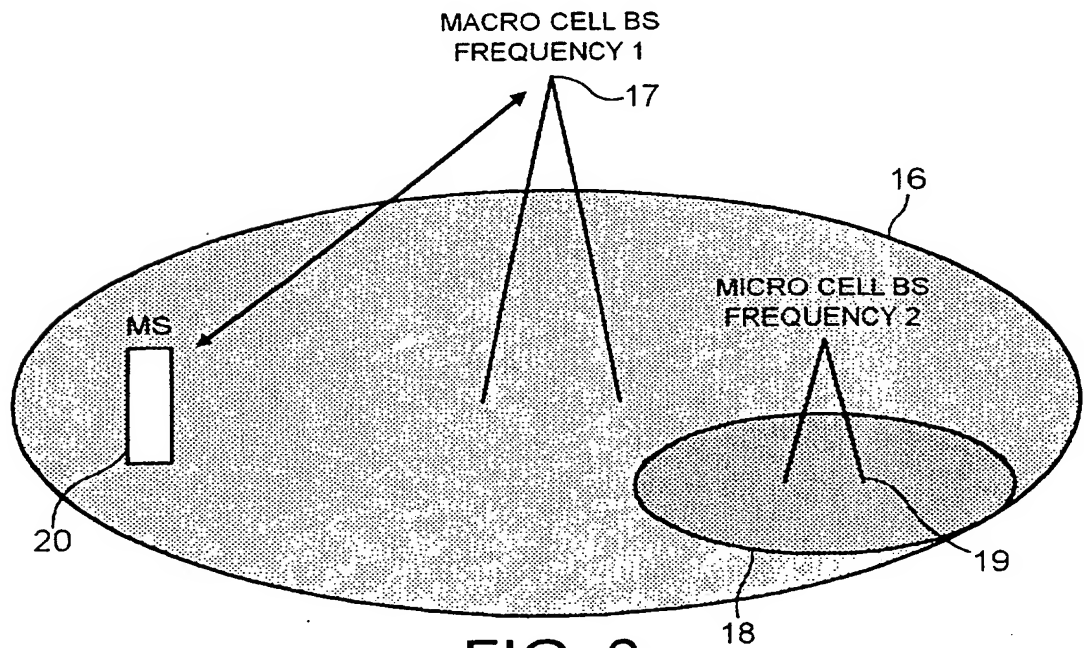


FIG. 2

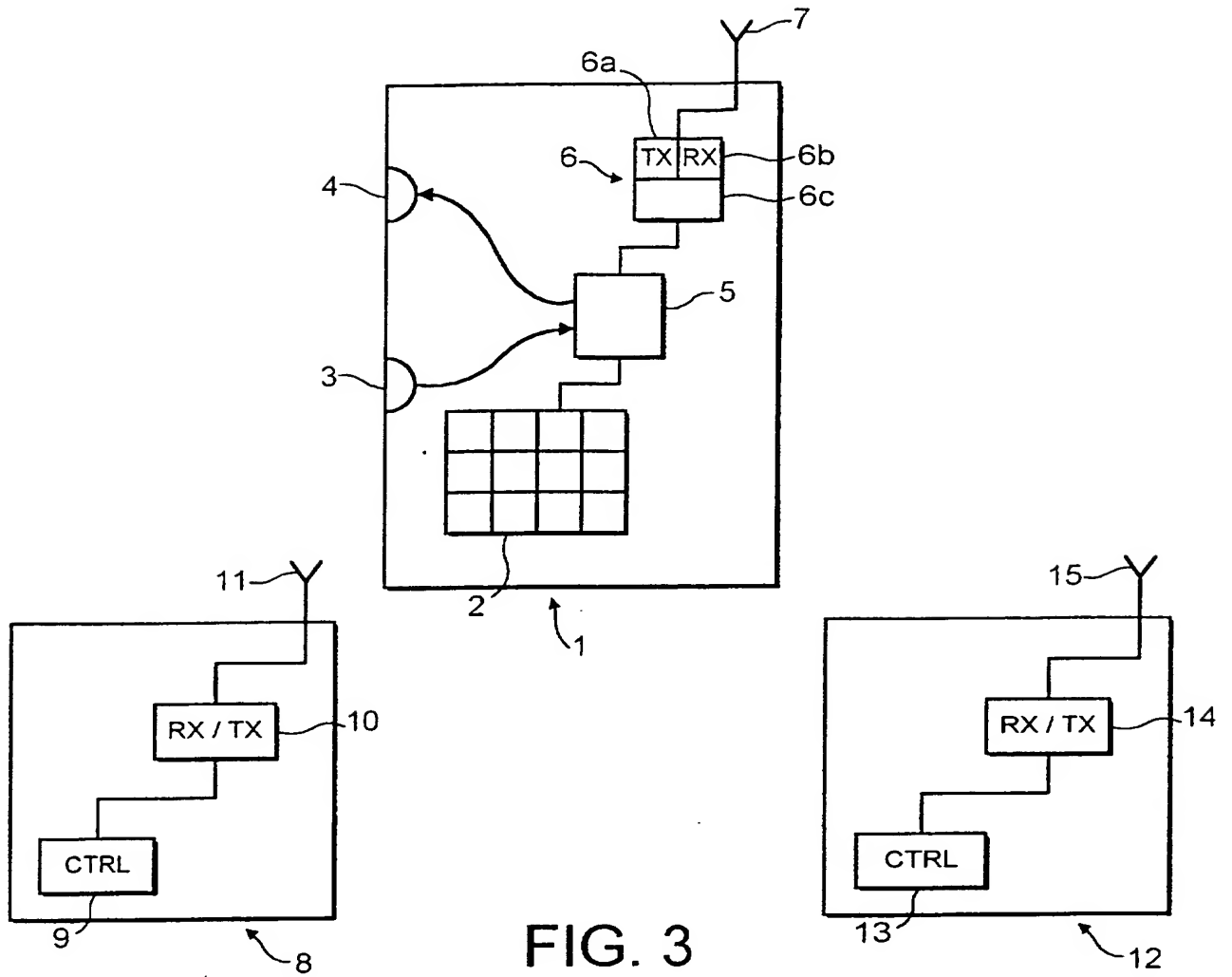


FIG. 3

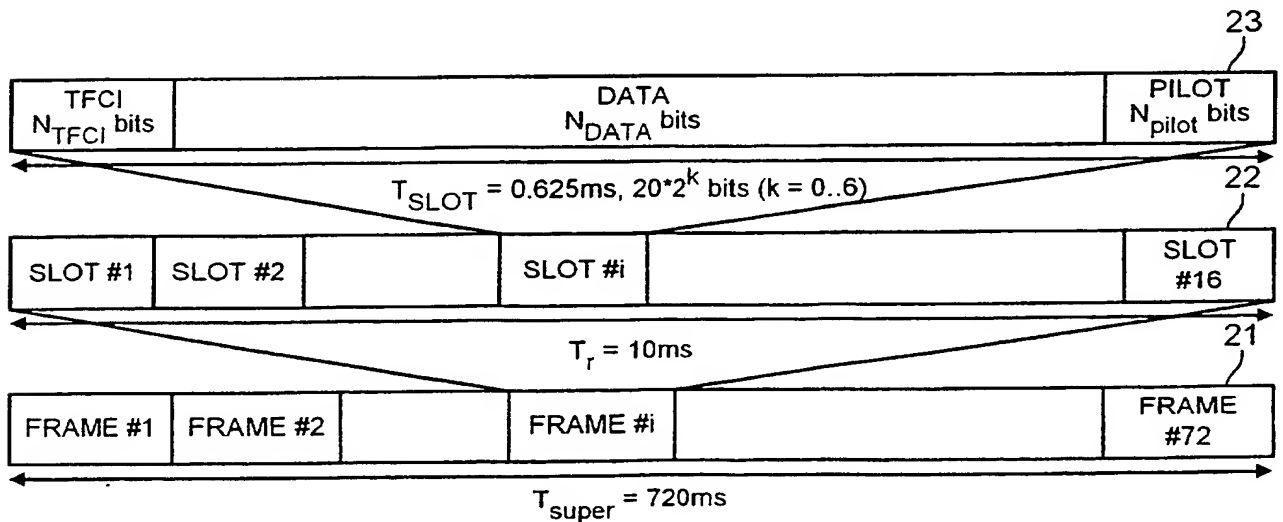


FIG. 4

INTER-FREQUENCY MEASUREMENT

- 5 This invention relates to an apparatus and method for communicating data in a spread spectrum communication system to allow inter-frequency measurements.

Multiple access communication systems allow a large number of users to
10 establish wireless communication channels over a relatively limited frequency spectrum. One multiple access communication system that has become increasingly prominent is the spread spectrum multiple access telecommunication system, otherwise known as code division multiple access (CDMA).

15 Multiple access in a CDMA system is achieved by assigning each user in the system a pseudo-random code, where the assigned pseudo-random codes have good auto- and cross-correlation properties. In use the assigned pseudo-random code is modulated with a user's bit rate signal. The bandwidth
20 of the modulated signal incorporating the pseudo-random code is much larger than the bandwidth of the user's bit rate signal, thereby spreading the user's relatively narrowband signal into a wide-band spread spectrum signal.

On receipt of the signal by a designated receiver the wideband signal is
25 converted back into a narrow band signal using the original pseudo-random code to 'de-spread' the signal.

Therefore, in a CDMA communication system a single wideband radio frequency can be assigned to each of the cellular areas that form the
30 communication system, where a plurality of unique spectrum spreading codes

are assigned to each area. As such, the number of users that can be multiplexed together is mainly limited by the amount of interference generated by transmissions rather than the radio frequency channels available.

- 5 However, there are occasions when more than one wideband radio channel is required in a CDMA cellular system. For example, different operators may assign different frequency bands or an operator may have a plurality of wideband radio channels of different frequencies to support different traffic volumes for different areas. City centres are likely to have a greater number of
- 10 users than rural areas. To accommodate this larger number more than one wideband CDMA frequency may be assigned, where each CDMA frequency has its own set of unique codes. Figure 1 shows four radio zones a to d where zone a is supported by two frequencies, zone b by three frequencies, zone c by two frequencies and zone d by one frequency. The number of frequencies
- 15 assigned is dependent on the traffic volume for each area.

Therefore, in a CDMA communication system a radio telephone having established a communication link over a particular frequency may require to be reassigned to a new frequency if the radio telephone moves from one zone

20 to another.

A further example of a hierarchical cell is shown in figure 2 which comprises a macro cell 16 with a base station 17 operating at one frequency incorporating a micro cell 18 with a base station 19 operating at a different frequency from

25 that of base station 17. The micro cell may, for example, be an office CDMA communication network. In this example, if radio telephone 20 has established a communication link with base station 17, the radio telephone 20 may need to perform an inter-frequency measurement (i.e. measure the strength of a signal transmitted on a different frequency) to determine whether

30 a handover to base station 19 should be performed.

Once a communication link has been established in a CDMA system between a radio telephone and a base station there is often a continuous downlink from the base station to the radio telephone. Therefore, if a radio telephone is to perform an inter-frequency measurement the radio telephone receiver will require to be tuned to another frequency potentially resulting in loss of data. This may be unacceptable to the user. One approach to overcome this problem has been to use a dual receiver where one receiver is used to perform an inter-frequency measurement while the other receiver is used for receiving data from the established communication link. However, a radio telephone may not have two or more receivers or the radio telephone may only be able to use the second receiver for receiver antenna diversity measurement.

It would be desirable to improve this situation.

In accordance with a first aspect of the present invention there is provided a spread spectrum communication network having a common channel, the channel comprising a plurality of frames for containing access channel data and paging channel data for communication to a plurality of radiotelephones, the spread spectrum communication network comprising a controller arranged to omit access channel data from a predetermined frame of the common channel to allow a radiotelephone to perform an inter-frequency measurement during the predetermined frame.

25

By omitting access channel data from a predetermined frame of the common channel this has the advantage of allowing a radiotelephone which has entered a mode which requires continuous reception of access channel data to perform an inter-frequency measurement during the predetermined frame without missing any access channel data.

30

Preferably the paging channel data for a radiotelephone is incorporated into a predetermined frame, wherein the controller is responsive to the radiotelephone entering a predetermined mode to omit access channel data for the radiotelephone from the predetermined frame.

This has the advantage of allowing a radiotelephone which has entered a mode which requires continuous reception of access channel data, and thereby not receptive to paging messages, to perform an inter-frequency measurement during the designated paging frame of the radiotelephone without missing any access channel data.

Preferably the predetermined mode is a continuous forward access channel mode.

15

In accordance with a second aspect of the present invention there is provided a spread spectrum radiotelephone for operation in a spread spectrum communication network having a common channel, the channel comprising a plurality of frames for containing access channel data and paging channel data for communication to a plurality of radiotelephones in which access channel data is omitted from a predetermined frame, the radiotelephone comprising a controller arranged to perform an inter-frequency measurement during the predetermined frame.

In accordance with a third aspect of the present invention there is provided a method of communicating data in a spread spectrum communication network to allow inter-frequency measurement, the method comprising communicating to a plurality of radiotelephones a common channel, the common channel having a plurality of frames for containing access channel data and paging channel data; arranging to omit access channel data from a predetermined

frame to allow a radiotelephone to perform an inter-frequency measurement during the predetermined frame.

5 For a better understanding of the present invention and to understand how the same may be brought into effect reference will now be made, by way of example only, to the accompanying drawings, in which:-

Figure 1 is a diagram of a zone structure of a spread spectrum communication system;

10

Figure 2 illustrates a macro/micro cell hierarchical spread spectrum communication system;

15 Figure 3 is a schematic diagram of a CDMA communication system according to the present invention;

Figure 4 illustrates the frame structure of a CDMA physical channel.

20 The following embodiment is described with reference to the 3rd Generation CDMA Partnership Project standard however the invention can be applied to other CDMA standards.

25 A wide-band CDMA (WCDMA) communication system comprises a WCDMA network and associated radiotelephones, between which communication channels are established. Figure 3 shows a CDMA communication system having a single radiotelephone 1 and a CDMA network with two base stations 8, 12. Typically a WCDMA communication system will have a plurality of radiotelephones, however for the purposes of describing this invention this embodiment will be described with reference to a single radiotelephone.

30

Base station 8 has an antenna 11, a transceiver 10 and a controller 9. The antenna is coupled to an input and output of the transceiver 10. The transceiver 10 is coupled to the controller 9. The transceiver 10 converts base-band data into a RF signal for transmission via antenna 11 and converts
5 a RF signal received via antenna 11 into base-band data. Controller 9 processes the received and transmitted data and controls the operation of the base-station 8, including the transmission of control data.

Base station 12 is of a similar construction to base station 8 where base
10 station 12 has an antenna 15, a transceiver 14 and a processor 13.

Radio telephone 1 has an antenna 7, a transceiver 6, a controller 5, a microphone 3, a keypad 2 and a speaker 4. The antenna 7 is coupled to an input and output of the transceiver 6. The transceiver 6 is coupled to the
15 controller 5. The controller 5 is coupled to microphone 3, keypad 2 and speaker 4.

The transceiver 6 comprises a transmitter 6a, a receiver 6b and a signal measuring device 6c. The transceiver 6 converts base-band data, via
20 transmitter 6a, into a RF signal for transmission via antenna 7 and converts a RF signal received via antenna 7 into base-band data, via receiver 6b. The signal measuring device 6c is arranged to measure the signal power of received RF signals.

25 Controller 5 processes the received and transmitted base-band data. The controller 5 controls sequencing of transceiver 6 and routes data between the microphone 3 and transceiver 6 and between transceiver 6 and speaker 4. The keypad 2 provides an interface between a user and the controller 5 for allowing a user of the radio telephone to make and receive calls.

A communication link is established between the radiotelephone 1 and a basestation 8, 12 over a CDMA physical channel. Physical channels are communication channels having a unique frequency and spreading code onto which are mapped transport channels.

5

Physical channels are made up of a three layer structure of superframes 21, frames 22 and time slots 23, as shown in figure 4. A superframe 21 has a duration of 720 ms and consists of 72 frames 22. A frame 22 has a duration of 10 ms and consists of 16 time slots 23. A time slot 23 contains information
10 symbols where the number of symbols per time slot depends on the physical channels.

The physical channels are grouped into dedicated uplink channels, common uplink physical channels, dedicated downlink physical channels and common
15 downlink physical channels.

The common downlink physical channels include a primary common control physical channel (PCCPCH), a secondary common control physical channel (SCCPCH) and a synchronisation channel (SCH).

20

The common uplink physical channels include a physical random access channel (PRACH).

Onto the physical channels are mapped various transport channels, as
25 described in 3rd Generation Partnership Project standard TS 25.211. The transport channels contain data for communication between users in the system. Transport channels are classified into two groups, common channels and dedicated channels. Common transport channels are mapped onto common physical channels where the common transport channels use in-
30 band identification when addressing specific radiotelephones. Dedicated

transport channels are mapped onto dedicated physical channels where the receiving radiotelephone 1 is identified by the physical channel i.e. code and frequency.

- 5 The PCCPCH has mapped onto it the broadcast control transport channel (BCCH). The BCCH is a downlink point to multipoint channel containing broadcast system and cell specific information (e.g. PRACH codes).

- 10 The SCCPCH has mapped onto it the forward access channel (FACH) and paging channel (PCH). The FACH is a downlink channel for carrying control information to a radio telephone when the network knows the location cell of the radio telephone. The FACH can also contain data packets and can, when a receiving radiotelephone is in a continuous FACH mode, be used for data transfer. In continuous FACH mode radiotelephone 1 continuously monitors
15 the FACH channel for packet data that is transmitted intermittently by a basestation 8, 12.

- 20 The PCH is a downlink channel for carrying control information to a radio telephone 1 indicating that a call is waiting for a radiotelephone 1. To increase the efficiency of identifying to a radiotelephone 1 that a call is waiting, radiotelephones registered with a network are placed into paging groups. Each paging group is allocated to a specific frame (i.e. a paging frame) where a plurality of paging groups can be assigned to the same specified frame. The paging frame contains paging information for the radiotelephones assigned to
25 the specified paging group(s).

- 30 The basestation controller 9, 13 is arranged to schedule the transmission of continuous FACH data and PCH data ensuring that continuous FACH data for a specific radiotelephone is omitted from the specified radiotelephone's paging frame. This provides the radiotelephone with a 10 ms period in which

to perform an inter-frequency measurement when the radiotelephone 1 is in continuous FACH mode without the risk of missing FACH data.

Alternatively, the basestation controller 9, 13 is arranged to schedule the transmission of continuous FACH data and PCH data ensuring to omit continuous FACH data from a designated frame (e.g. frame 1). This alternative embodiment also provides the radiotelephone with a 10 ms period in which to perform an inter-frequency measurement when the radiotelephone 1 is in continuous FACH mode without the risk of missing FACH data.

10

The SCH is a downlink channel containing network synchronisation data to allow a radiotelephone 1 to synchronise to the network. Accordingly, a base station 8, 12 will constantly transmit synchronisation data.

15 The up-link PRACH has mapped onto it the random access channel (RACH). The RACH is an uplink channel used for carrying control information from the radio telephone 1 to a base station 8, 12.

When the radio telephone 1 is first powered up it initialises and registers with the network using the SCH to acquire synchronisation to the strongest base station 8, 12. Once synchronisation has occurred the radio telephone 1 detects the PCCPCH, reading the system and cell specific BCCH information. From the BCCH the radio telephone 1 acquires the PRACH codes allowing the radio telephone 1 to place a request with a base station 8, 12 to allow the radio telephone 1 to place a call. Radiotelephone 1 also determines from the BCCH which paging group it has been assigned to and hence which frame will contain paging information for radiotelephone 1.

In this embodiment base station 8 supports zone b while base station 12 supports zone c, as shown in figure 1. Initially the radiotelephone 1 is

powered up in zone b registering, as described above, with base station 8 and assigned to operate on channel frequency 3.

The radio telephone 1 needs to determine transmit power of the transmitter 6a.

- 5 The radio telephone 1 achieves this by estimating the uplink path loss from measurements of the received base station power and uses this path loss estimate together with the uplink received interference level and received signal to interference ratio target to decide the transmit power.

- 10 After initialisation, the radiotelephone 1 enters idle mode and waits to be paged for an incoming call or for the user to place a call.

- If, for example, a user wishes to place a call which requires radiotelephone 1 to enter a continuous FACH mode the radio telephone 1 transmits to the base station 8 a random access message over the PRACH.
- 15

Upon reception of the random access message the base station 8 responds with an access grant message on the FACH.

- 20 On receipt of the access grant message, radiotelephone 1 enters continuous FACH mode scanning the SCCPCH for data. On receipt by base station 8 of packet data from another part of the network (not shown) for radiotelephone 1 the base station 8 transmits the data on the FACH channel using in-band signalling to address the data to radiotelephone 1.

25

- Basestation controller 9 schedules the transmission of the received data in the SCCPCH frames ensuring not to include data in the paging frame for radiotelephone 1. Therefore, the radiotelephone 1 has a predetermined frame in the SCCPCH (i.e. is guaranteed a period of 10 ms) in every superframe 21
- 30 in which the radiotelephone 1 can tune to another frequency to perform an

inter-frequency measurement without the risk of missing FACH data addressed to radiotelephone 1.

Alternatively, the basestation controller 9 can schedule the transmission of the FACH data for radiotelephone 1 in any of the frames with the exception of a designated frame (e.g. frame 1) of a superframe 21. When a radiotelephone 1 registers with the base station 8 the radiotelephone is informed as to which is the designated frame. Therefore, in this alternative embodiment, radiotelephone 1 also has a predetermined frame in the SCCPCH (i.e. is guaranteed a period of 10 ms) in every superframe 21 in which the radiotelephone 1 can tune to another frequency to perform an inter-frequency measurement without the risk of missing FACH data addressed to radiotelephone 1.

Alternatively, the continuous FACH mode can be used by the telecommunication network to indicate to a radiotelephone when and where packet data is to be transmitted (i.e. provide a channel identification and transmission period). For example, the access channel data may indicate that the packet data is to be transmitted on a different common channel or that a dedicated channel is to be established. In this embodiment the access channel data indicating when and where the packet data is to be transmitted will not be incorporated in the respective paging frames.

Having established a connection between radio telephone 1 and base station 8, as described above, it may be necessary to perform a handover to another base station, for example if the radio telephone 1 starts to move out of zone b. If radio telephone 1 moves to zone c it will be necessary to perform a handover to base station 12 as the signal from base station 8 will become too weak to maintain a connection. However, as base station 12 does not operate on the same frequency as channel 3 of base station 8 it will be necessary for

radio telephone 1 to perform an inter-frequency measurement to determine the strength of the signal from base station 12 while the radio telephone 1 maintains a connection with base station 8.

- 5 To determine whether the connection should be switched to another zone the radio telephone's 1 signal measuring means 6c in the transceiver 6 measures the signal strength of the existing connection with base station 8. The signal strength of other zones then need to be measured to determine whether a stronger signal can be received.

10

To perform an interfrequency measurement the radiotelephone controller 5 instructs the transceiver 6 to tune to the frequency of another CDMA channel during the predetermined frame (i.e. the paging frame or designated frame). In this example radiotelephone 1 tunes to channel 2 in zone c.

15

The signal measuring device 6c measures the signal strength of channel 2 during the 10 ms period of the predetermined frame. Before a new frame is received the radiotelephone's controller 5 instructs the transceiver 6 to tune to the original channel 3 to avoid loss of FACH data.

20

Based on the measured signal measurements controller 5 determines whether to switch to another channel.

- 25 It will be appreciated by a person skilled in the art that this invention would also apply to the placing of a call to radiotelephone 1.

The present invention may include any novel feature or combination of features disclosed herein either explicitly or implicitly or any generalisation thereof irrespective of whether or not it relates to the present claimed
30 invention or mitigates any or all of the problems addressed. In view of the

foregoing description it will be evident to a person skilled in the art that various modifications may be made within the scope of the invention. For example, the radio channels having different frequencies may be on different communication networks.

CLAIMS

1. A spread spectrum communication network having a common channel,
the channel comprising a plurality of frames for containing access
channel data and paging channel data for communication to a plurality
of radiotelephones, the spread spectrum communication network
comprising a controller arranged to omit access channel data from a
predetermined frame of the common channel to allow a radiotelephone
to perform an inter-frequency measurement during the predetermined
frame.
2. A spread spectrum communication network having a common channel,
the channel comprising a plurality of frames for containing access
channel data and paging channel data for communication to a plurality
of radiotelephones, with the paging channel data for a radiotelephone
being incorporated into a predetermined frame, the spread spectrum
communication network comprising a controller responsive to the
radiotelephone entering a predetermined mode to omit access channel
data for the radiotelephone from the predetermined frame to allow the
radiotelephone to perform an inter-frequency measurement during the
predetermined frame.
3. A spread spectrum communication network according to claim 2,
wherein the predetermined mode is a continuous forward access
channel mode.
4. A spread spectrum communication network according to claim 2 or 3,
wherein the plurality of radiatelephones are arranged in paging groups,
the paging channel data for a paging group being incorporated into a
predetermined frame.

5. A spread spectrum communication network according to any of claims 2 to 4, wherein the access channel data and paging channel data incorporate in-band identification information for identifying the receiving radiotelephone.
6. A spread spectrum communication network substantially as hereinbefore described with reference to respective drawings of the accompanying description.
7. A spread spectrum radiotelephone for operation in a spread spectrum communication network having a common channel, the channel comprising a plurality of frames for containing access channel data and paging channel data for communication to a plurality of radiotelephones in which access channel data is omitted from a predetermined frame, the radiotelephone comprising a controller arranged to perform an inter-frequency measurement during the predetermined frame.
8. A spread spectrum radiotelephone substantially as hereinbefore described with reference to respective drawings of the accompanying description.
9. A method of communicating data in a spread spectrum communication network to allow inter-frequency measurement, the method comprising communicating to a plurality of radiotelephones a common channel, the common channel having a plurality of frames for containing access channel data and paging channel data; arranging to omit access channel data from a predetermined frame to allow a radiotelephone to

perform an inter-frequency measurement during the predetermined frame.

- 5 10. A method of communicating data in a spread spectrum communication network to allow inter-frequency measurement, the method comprising communicating to a plurality of radiotelephones a common channel, the common channel having a plurality of frames for containing access channel data and paging channel data with the paging channel data for a radiotelephone being incorporated into a predetermined frame;
- 10 arranging in response to a radiotelephone entering a predetermined mode to omit access channel data for the radiotelephone from the predetermined frame to allow the radiotelephone to perform an inter-frequency measurement during the predetermined frame.
- 15 11. A method substantially as hereinbefore described with reference to respective drawings of the accompanying description.



INVESTOR IN PEOPLE

Application No: GB 9922737.3
Claims searched: 1-10

Examiner: Hannah Bryant
Date of search: 1 April 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK Cl (Ed.R): H4L (LDSHX, LFMX, LFMA, LDLS)
Int Cl (Ed.7): H04Q 7/34, 7/38, H04B 7/26, 1/10, 17/00
Other: Online: WPI EPODOC JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB2336071A (KONINKLIJKE)	
A	GB2331205A (LG)	
A	WO0003501 (JONES)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.